MAR07-2006-001764

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

High Performance Thermal Imaging Using Quantum Well Infrared Photodetector Arrays

HARALD SCHNEIDER, Forschungszentrum Rossendorf, Institute of Ion-Beam Physics and Materials Research

Quantum well infrared photodetector (QWIP) technology has opened up new opportunities to realize focal plane arrays (FPA) for high-performance thermal imaging [1]. High thermal and spatial resolution, low 1/f noise, low fixed-pattern noise, and high pixel operability makes QWIP FPAs appropriate for many applications. Due to their narrow absorption bands with relative spectral widths $\Delta\lambda/\lambda$ of the order of 10%, QWIPs are particularly suitable for thermal imaging applications involving several atmospheric transmission bands or several colors within the same band. For dual-band/dual-color FPAs, QWIP technology has the unique property that the active region for the long-wavelength band is transparent for the short-wavelength band. In this talk, I will report on typical QWIP structures optimized for thermal imaging applications and on the performance of some state-of-the-art QWIP cameras which were jointly realized by the Fraunhofer-Institute for Applied Solid State Physics (Freiburg, Germany) and AIM Infrarot-Module GmbH (Heilbronn, Germany). Besides imagers for the 8 – 12 μm long-wavelength infrared (LWIR) and 3 – 5 μm mid-wavelength infrared (MWIR) regimes, these include a LWIR/MWIR dual-band QWIP FPA with 384x288 pixels which, at 6.8 ms integration time, exhibits a noise-equivalent temperature difference as low as 20.6 mK in the LWIR and 26.7 mK in the MWIR spectral bands. A specially designed diffraction grating is used for optical coupling of both spectral regimes. The array, which is based on a photoconductive QWIP for the MWIR and a photovoltaic "low-noise" QWIP for the LWIR, allows for synchronous and pixel-registered image acquisition in both bands. This functionality yields several advantages, including better distinction between target and background clutter, operation in a much wider range of ambient conditions, and the ability of remote absolute temperature measurement.

[1] H. Schneider and H. C. Liu, *Quantum Well Infrared Photodetectors: Physics and Applications*, ISBN 3540363238, Springer Series in Optical Sciences Vol. 126, 2006.